

## **ATTACHMENT E**

The Chlorine Dioxide Handbook  
Water Disinfection Series

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## ANALYSIS METHODS Analytical Chemistry

The titration procedures described in this chapter require that calculations and conversions be made based on the chemistry of the method. For example, the amperometric titration makes use of equivalent weights for calculating concentrations on the basis of mass. The term *equivalent weight* is defined as the number of milligrams per equivalents (mg/eq) and is calculated by dividing the molecular weight of the species being measured by the number of electrons transferred during the reaction. Table 6-2 lists the common oxychlorine species, their molecular weights, and the corresponding equivalent weights used in calculating final concentrations during the amperometric titration.

For example, in amperometric method II (see page 109),  $\text{ClO}_3^-$  is calculated based on the equivalents of reducing titrant required to react with equivalents of oxidant present at a specific pH. Chlorate ion

Oxidation state	Species	Formula /	Table 6-1 Chlorine oxidation states
+7	Perchlorate ion	$\text{ClO}_4^-$	
+6		-	
+5	Chlorate ion	$\text{ClO}_3^-$	
+4	Chlorine dioxide	$\text{ClO}_2$	
+3	Chlorite ion Chlorous acid	$\text{ClO}_2^-$ $\text{HClO}_2$	
+2		-	
+1	Hypochlorite ion Hypochlorous acid	$\text{OCl}^-$ $\text{HOCl}$	
0	Chlorine	$\text{Cl}_2$	
-1	Chloride ion	$\text{Cl}^-$	

Species	Molecular weight (g/mol)	Electrons transferred	Equivalent weight (mg/eq)	Table 6-2 Equivalent weights for oxychlorine species
$\text{ClO}_2 \rightarrow \text{ClO}_2^-$	67.452	1	67,452	
$\text{ClO}_2 \rightarrow \text{Cl}^-$	67.452	5	13,490	
$\text{Cl}_2 \rightarrow 2 \text{Cl}^-$	70.906	2	35,453	
$\text{ClO}_2^- \rightarrow \text{Cl}^-$	67.452	4	16,863	
$\text{ClO}_3^- \rightarrow \text{Cl}^-$	83.451	6	13,909	

NOTE: During titration at a specified pH, oxychlorine species are reacted (electrons transferred) to form other species (e.g.,  $\text{Cl}^-$ ).